



Caltrans Division of Research,
Innovation and System Information

Research Results

Planning/
Policy/
System
Information

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Project Title:

Sustainable Transportation Energy
Pathways (STEPS)

Task Number: 1537

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This high-profile, publicly and privately supported project addresses the need to develop new theory, tools, and methods that allow for transparent comparisons of promising alternative energy models and creative vehicle solutions to help Caltrans determine their potential benefits in its own fleet and beyond, as well as further the goal of greener and more environmentally-responsible business practices.

Project Manager:

Patrick Tyner, Associate
Transportation Planner
Patrick.Tyner@dot.ca.gov

Sustainable Transportation Energy Pathways (STEPS)

Hydrogen, biofuels, electricity, and fossil fuels are the four fuel pathways at the core of the STEPS research

WHAT WAS THE NEED?

Global demand for transportation mobility is exploding, particularly in the developing world where the number of vehicles on the road increases five to six percent every year. Worldwide, this number is projected to triple by the year 2050, according to the International Energy Agency (IEA). Energy supply is a critical concern, especially for the transportation sector. Over the last century, our transportation system has been based almost exclusively on petroleum and the internal combustion engine. With the cost of conventional crude oil rising, and petroleum substitutes, including unconventional oil from shale and tar sands, facing economic, technical, and environmental challenges, vehicles powered by alternative energy sources are in more demand than ever before.

A variety of high-efficiency vehicles, including those with hybrid drive trains and fuel cells along with battery electric vehicles, as well as new fuels, such as compressed natural gas, ethanol, methanol, dimethyl ether, Fischer-Tropsch process diesel, electricity, and hydrogen, are now securely on the table as potential solutions to address climate change, energy supply, and security concerns. Government and industry are seeking solutions and effective transition strategies for a sustainable transportation future.

WHAT WAS OUR GOAL?

The project's goal was to inform public debate on alternative energies and vehicles, form and work with a consortium of public-private sponsors, explore transportation alternatives, develop and apply theory, tools, methods, and research data in comparative assessments focusing on four general transportation energy pathways: hydrogen, biofuels, electricity, and fossil fuels.



Caltrans improves mobility across California by performing applied research, developing innovations, and implementing solutions.

WHAT DID WE DO?

Over the course of four years, STEPS researchers conducted impartial, comparative analyses of alternative fuel and vehicle pathways. Using an interdisciplinary approach, they drew on engineering, economics, environmental science, and consumer behavior to inform their industrial and government sponsors about the cost-benefit potential of the four transportation energy pathways identified for this project. They explored the technical aspects, costs, market issues, environmental implications, and transition issues for each individual pathway.

Analyzing single-fuel pathways provided a strong basis for comparing different fuels and developing scenarios for how the fuel/vehicle pathways might be integrated to meet society's goals. The research flowed naturally from single pathway analyses to robust comparisons of fuel pathways; then to integrative scenarios and transition analyses for future vehicles and fuels; and finally, to case studies to inform carbon and alternative fuel policies in California, the United States, and beyond in the interest of reducing greenhouse gas emissions and oil dependency.

WHAT WAS THE OUTCOME?

As STEPS researchers assessed the prospects and compared the characteristics, costs and benefits for alternative vehicles and fuels (biofuels, electricity, and hydrogen), new scenarios began taking shape detailing how these future technologies might transform the transportation sector and what policies would need to be implemented to support this complex transition over the next few decades.

Achieving aggressive targets for sustainable transportation requires a portfolio approach that combines new vehicle and fuel technologies, behavioral changes, and newly crafted policies. One new policy instrument, known as a low-carbon fuel standard (LCFS), could be a promising approach to getting the carbon out of fuels if it inspires industry to pursue innovation aggressively and is flexible and performance-based. Just one idea of many, strategies within this portfolio are expected to vary widely from region to region.

Key results for the STEPS program include:

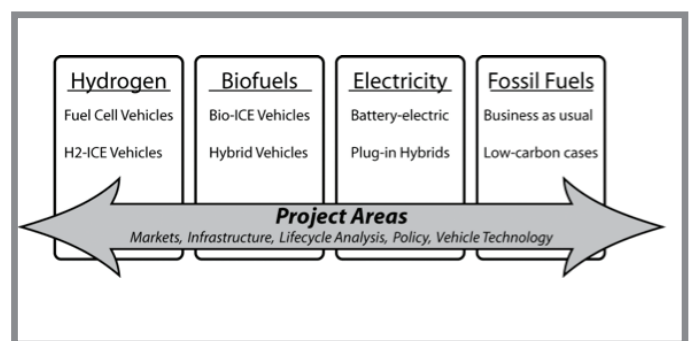
- Over 130 books, chapters, and major journal articles and numerous research reports published
- Completion of more than 30 research projects
- Twelve symposia, consortium meetings, and policymaker outreach events
- Publication of *Sustainable Transportation Energy Pathways: a Research Summary for Decision Makers*, edited by Joan Ogden and Lorraine Anderson, UC Davis Institute of Transportation Studies—the core publication that summarizes the lessons learned from the STEPS project

WHAT IS THE BENEFIT?

Caltrans will distribute the STEPS program results for management decision-making and policy development for future activities concerning alternative fuel usage and transportation and environmental sustainability. This research will allow Caltrans to determine the potential benefits of all alternative fuel types in its own vehicle and equipment fleet and further the goal of promoting and utilizing cleaner fuels in support of greener and more environmentally-responsible business practices.

LEARN MORE

For more about the STEPS book, *Sustainable Transportation Energy Pathways: A Research Summary for Decision Makers*, see <http://steps.ucdavis.edu/STEPS.Book>



Sustainable Transportation Energy Pathways (STEPS) research is organized around these four fuel pathways.